

WHAT IS CLAIMED IS:

1. An electrode for a secondary electrochemical cell comprising nanostructured material of formula  $\text{Si}_{(1-z)}\text{Ge}_z$  or a alkali metal alloy thereof, wherein  $0 < z \leq 1$ .
2. The electrode of claim 1, wherein the alkali metal alloy is a lithium alloy.
3. The electrode of claim 1, wherein the nanostructured material comprises a nanoparticle.
4. The electrode of claim 3, wherein the nanoparticle has a diameter of not greater than about 300 nm.
5. The electrode of claim 4, wherein the nanoparticle has a diameter of not greater than about 100 nm.
6. The electrode of claim 5, wherein the nanoparticle has a diameter of not greater than about 50 nm.
7. The electrode of claim 1, wherein the nanostructured material is a nanofilm.
8. The electrode of claim 7, wherein the nanofilm has a thickness of not greater than about 500 nm.
9. The electrode of claim 8, wherein the nanofilm has a thickness of not greater than about 200 nm.
10. The electrode of claim 9, wherein the nanofilm has a thickness of not greater than about 100 nm.
11. The electrode of claim 2, wherein the lithium alloy of the nanostructured material has the formula  $\text{Li}_x\text{Si}_{(1-z)}\text{Ge}_z$ , wherein  $x$  is at least about 1.
12. The electrode of claim 11, wherein the lithium alloy of the nanostructured material has the formula  $\text{Li}_x\text{Si}_{(1-z)}\text{Ge}_z$ , wherein  $x$  is at least about 2.5.
13. The electrode of claim 1, wherein the nanostructured material has a cycle life that is stable over at least about 10 cycles.
14. The electrode of claim 13, wherein the nanostructured material has a cycle life that is stable over at least about 20 cycles.
15. The electrode of claim 1, wherein the nanostructured material exhibits a rate capability of at least about 1C.
16. The electrode of claim 1, further comprising a binder and/or adhesive.

17. The electrode of claim 1, further comprising a substrate.
18. The electrode of claim 17, wherein the substrate is a current collector.
19. A secondary electrochemical cell comprising an anode, a cathode, and an electrolyte, wherein the anode comprises nanostructured material of formula  $\text{Si}_{(1-z)}\text{Ge}_z$  or a lithium alloy thereof, wherein  $0 < z \leq 1$ .
20. The secondary electrochemical cell of claim 19, wherein the secondary electrochemical cell is an electrochemical supercapacitor.
21. The secondary electrochemical cell of claim 19, wherein the secondary electrochemical cell is fabricated on an integrated device.
22. A method of synthesizing a nanoparticle of formula  $\text{Si}_{(1-z)}\text{Ge}_z$ , wherein  $0 < z \leq 1$ , the method comprising evaporating elemental germanium into a gas, thereby forming a nanoparticle, wherein the gas comprises hydrogen.
23. The method of claim 22, further comprising evaporating elemental silicon into a gas.
24. The method of claim 22, wherein the nanoparticle is entrained in the gas, the method further comprising:
  - accelerating the gas and entrained nanoparticle; and
  - depositing the nanoparticle on a substrate.
25. The method of claim 22, wherein the nanoparticle has a diameter of not greater than about 300 nm.
26. A nanoparticle of formula  $\text{Si}_{(1-z)}\text{Ge}_z$ , wherein  $0 < z \leq 1$ , synthesized by a method comprising evaporating elemental germanium into a gas, thereby forming a nanoparticle, wherein the gas comprises hydrogen.
27. The nanoparticle of claim 26, wherein the method further comprises evaporating elemental silicon into a gas.
28. The nanoparticle of claim 26, wherein the nanoparticle is entrained in the gas, the method further comprising:
  - accelerating the gas and entrained nanoparticle; and
  - depositing the nanoparticle on a substrate.

29. The nanoparticle of claim 26, wherein the nanoparticle has a diameter of not greater than about 300 nm.